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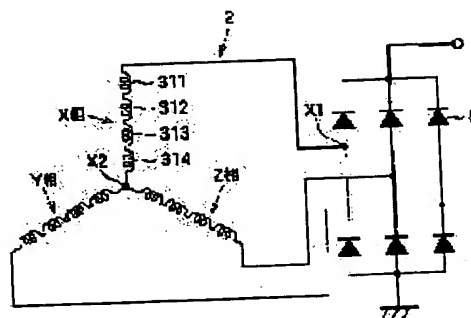
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## (54) STATOR OF AC GENERATOR FOR VEHICLE

(57)Abstract:

**PROBLEM TO BE SOLVED:** To conduct jointing work of a plurality of segments by means of an automatic device suitable for mass production without need for manual work by a worker, by forming a single phase of winding out of a lap winding and a wavy winding mixed with each other.

**SOLUTION:** This stator of an AC generator for vehicle involves a stator core having a plurality of stators and a stator winding formed by connecting a plurality of electric conductors mounted on the stator core. A single phase winding included in the stator winding is formed by connecting lap windings 311, 313 and wavy windings 312, 324. The electric conductor forming a part of the lap windings 311, 313 and the electric conductor forming part of the wave windings 312, 324 are disposed inside one slot. It is thus possible to conduct jointing work of plurality of segments by means of an automatic device suitable for mass production.



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 CLAIMS

[Claim(s)]

[Claim 1] A stator core with two or more slots (35) (32) The stator winding which comes to connect two or more electric conductors (33) with which the aforementioned stator core (32) was equipped. The coil (315) of the phase of 1 which is the stator of the AC generator for vehicles equipped with the above, and is contained in the aforementioned stator winding. The coil (311 313) of a lap winding and the coil (312 324) of a wave winding are connected, and it is constituted. in the one aforementioned slot (35) It is characterized by arranging the aforementioned electric conductor (33) which constitutes a part of coil (311 313) of the aforementioned lap winding, and the aforementioned electric conductor (33) which constitutes a part of coil (312 324) of the aforementioned wave winding.

[Claim 2] The AC generator for vehicles according to claim 1 characterized by for even the aforementioned slot (35) hitting  $(4n+2)$ , and arranging the aforementioned electric conductor (33) of a book ( $n$  : natural number).

[Claim 3] A stator core with two or more slots (35) (32) The stator winding which comes to connect two or more electric conductors (33) with which the aforementioned stator core (32) was equipped. It is the stator of the AC generator for vehicles equipped with the above. to the aforementioned stator core (32) Even the aforementioned slot (35) hits  $(4n+2)$ , and the aforementioned electric conductor (33) of a book ( $n$  : natural number) is arranged. The first coil and group (31a) which are formed in one side of the shaft-orientations end face of the aforementioned stator core (32), and come to arrange the connection of the aforementioned electric conductor (33) to multiplex, It has the second coil and group (31b) which are formed in another side of the shaft-orientations end face of the aforementioned stator core (32), and sets in the second coil of the above, and a group (31b). the aforementioned electric conductor (33) It is characterized by connecting so that the coil (311 313) of a lap winding and the coil (312 314) of a wave winding may be intermingled.

[Claim 4] Connection of the aforementioned electric conductor (33) is the stator of the AC generator for vehicles according to claim 3 characterized by being made by the turn section (331c, 332c, 333c), and being made by junction in the second coil of the above, and a group (31b) in the first coil of the above, and a group (31a).

[Claim 5] The aforementioned electric conductor (33) is arranged only in the direction of a path in the aforementioned slot (35), and it sets in the first coil of the above, and a group (31a). the aforementioned electric conductor (33) The aforementioned electric conductor (33) with same array turn from the direction outermost-layer-of-drum side of a path within the slot (35) of 1 and array turn from the direction innermost layer side of a path within other slots (35) is connected. In the second coil of the above, and a group (31b) the aforementioned electric conductor (33) The stator of the AC generator for vehicles according to claim 3 or 4 characterized by connecting the aforementioned electric conductor (33) which is extended by the hoop-direction retrose by turns from the direction outermost-layer-of-drum side of a path within the slot (35) of 1, is extended from a different slot (35), and adjoins in the direction of a path.

[Claim 6] The coil (312 314) of the aforementioned wave winding is the stator of the AC generator for vehicles of any one publication of a claim 1 to the claim 5 characterized by being enclosed by the coil (311 313) of the aforementioned lap winding.

[Claim 7] The aforementioned stator winding is the stator of the AC generator for vehicles of any one publication of a claim 2 to the claim 6 with which even the aforementioned slot (35) is characterized by the neighboring number of turns being a turn  $(4n+2)$  ( $n$  : natural number).

[Claim 8] It is the stator of the AC generator for vehicles of any one publication of a claim 2 to the claim 6 with which 2 \*\*\*\*s of the aforementioned stator windings are used as the coil whose neighboring number of turns is a turn  $(2n+1)$  ( $n$  : natural number), and even the aforementioned slot (35) is characterized by carrying out parallel connection of this coil carried out 2 \*\*\*\*s.

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[Translation done.]

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the stator of the AC generator for vehicles which can be carried in vehicles, such as vessels, such as a passenger car and a truck, about the AC generator driven with an internal combustion engine.

[0002]

[Description of the Prior Art] What constitutes the coil of one phase as coil structure of the stator of the AC generator for vehicles using a successive line without eye the next is known. Moreover, the structure which joins the edge of a segment and constitutes a series of coils is known using the segment of a large number (this crooked portion is hereafter called the turn section) beforehand crooked in the shape of a hairpin.

[0003] As a stator of the AC generator for vehicles using the segment, composition given in an international public presentation/[ 92nd ] No. 06527 pamphlet (1992) is known. The joint of a segment is annularly arranged in one side of a stator core, and the composition make junction by soldering or welding easy to automate is proposed by the above-mentioned conventional technology. According to the composition shown here, four segments are arranged in a slot. And the segment corresponding to each reversal connection and middle connection of a coil is created individually beforehand, it arranges in a slot, and the wave volume stator winding of 4 turns is formed per one phase by joining these.

[0004]

[Problem(s) to be Solved by the Invention] For the international public presentation/[ 92nd ] No. 06527 pamphlet (1992), the wave winding of 4 turns is formed in an outer layer [ within one slot ], and inner layer side like drawing 13 using the segment arranged two [ at a time ]. The coil specification view for one phase is shown in drawing 12. Here, the number on a par with the central horizontal single tier of drawing expresses the slot number. Moreover, the solid line of drawing 12 expresses the coil of 1 turn which consists of electric conductors inserted in the position of A of drawing 13, similarly, in the dashed line, B and the two-dot chain line correspond to C, and the dashed line corresponds to the position of D.

[0005] Two or more basic segments 105 with the same length and the same configuration are contained in two or more segments. This basic segment 105 is arranged so that the two bays may be located in basic 1 pole-pitch remote slot, respectively. And two or more basic segments are arranged regularly, and the coil of 1 turn which carries out a stator core 1 round is formed by being joined regularly.

[0006] However, with this conventional technology, since four electric conductors are held in one slot, the wave winding which carries out a stator core 4 round is formed. For this reason, in order to carry out the series connection of the wave winding of each periphery, the variant segment of a configuration which is different in a basic segment 105 is used. With this conventional technology, the variant segment 102 which connects the variant segment 101 which connects the 3rd round with the 100 or 2nd round of the variant segment which connects the 2nd round with the 1st round and the 3rd round, and the 4th round is used.

[0007] Furthermore, in order to form two leader lines X1 and X2 as an outgoing end of a coil, two variant segments 103 and the variant segment 104 are used. Therefore, with this conventional technology, in order to form the coil of 4 turns of one phase, a total of five variant segments are needed. thus, with the composition of the conventional technology, the variant segment of "T+1" book is made required to the number "T", i.e., number of turns, of the electric conductor arranged in a slot. From such a number of turns, with the composition of the conventional technology, the arrangement work of a segment is done complicated and productivity is reduced.

[0008] Moreover, in electric conductor arrangement of the inside-and-outside double layer of the conventional technology, and a hoop-direction double row, the slot of the large cross section is searched for and the cross section of

the teeth which let magnetic flux pass relatively must be decreased. Now, the magnetic flux to interlink will decrease. Moreover, although it is necessary to arrange so that an electric conductor may make even layers in the direction of a path in a slot in order to avoid interference of the basic segment in a coil end and to arrange a basic segment regularly in a coil end, with the conventional technology based on the direction of path two-layer, and hoop-direction 2 train, realization is difficult in the many turns of 4 or more \*\*\*\*\*.

[0009] For example, although six turns can be constituted if a hoop direction is made into three trains, the slot of big width of face is searched for, and there is a trouble that the cross section of teeth decreases relatively. Furthermore, the interval of the hoop direction of the joint which joins a segment becomes small, and the insulation between joints becomes difficult. For this reason, the composition which makes the train of a hoop direction two or more trains has a practical problem.

[0010] Moreover, if the layer of the direction of a path is made into four layers, although eight turns are possible, since the electric conductor of the multiple of 4 is held in 1 slot, only the coil of the specific number of turns can be constituted. Now, the output characteristics by which the flexibility of the number of turns is low and is needed for the AC generator for vehicles might be unrealizable. Moreover, with the above-mentioned conventional technology, there is a publication of the purport that a stator winding can be made into a lap winding (loop volume) using a segment. However, the publication which is the grade which can carry out the lap winding which used the segment is not carried out to the above-mentioned conventional technology.

[0011] this invention aims at offering the stator of the AC generator for vehicles with the coil with which may be satisfied of the output characteristics demanded, avoiding interference of the basic segment in a coil end. this invention aims at offering the stator of the AC generator for vehicles with the predetermined number of turns called for, avoiding interference of the basic segment in a coil end.

[0012] this invention aims at lessening the number of variant segments. this invention aims at suppressing proximity of the joint of the segment in a coil end. this invention aims at offering the stator of the AC generator for vehicles equipped with the coil of an odd number turn.

[0013] this invention aims to let the junction work of two or more segments offer the stator of the easy AC generator for vehicles. this invention aims at offering the stator of the AC generator for vehicles which can carry out the junction work of two or more segments with the automated equipment suitable for mass production method, without being based on an operator's handicraft.

[0014] [Means for Solving the Problem] In order to attain the above-mentioned purpose, in invention according to claim 1 The coil (315) of the phase of 1 contained in a stator winding The coil (311 313) of a lap winding and the coil (312 324) of a wave winding are connected, and it is constituted. in one slot (35) It is characterized by arranging the electric conductor (33) which constitutes a part of coil (311 313) of a lap winding, and the electric conductor (33) which constitutes a part of coil (312 324) of a wave winding.

[0015] Since the coil (311 313) of a lap winding and the coil (312 324) of a wave winding are made intermingled and the coil (315) of one phase is constituted by this, the output characteristics demanded are realizable. In invention according to claim 2, it is characterized by for even a slot (35) hitting  $(4n+2)$  and arranging the electric conductor (33) of a book  $(n : \text{natural number})$ . Thereby, the electric conductor (33) of the odd multiples of a book  $(4n+2)$  (6, 10, 14 ....) is arranged in a slot (35), and a coil can be constituted.

[0016] In invention according to claim 4, connection of electric conductors (33) is characterized by being made using the successive line in the first coil and the group (31a), and being made by junction in the second coil and a group (31b). Thereby, each electric conductor (33) is formed as a U character-like segment (331, 332, 333). And in the first coil and a group (31a), electric conductors (33) will be connected in the turn section (331c, 332c, 333c) of a U character-like segment (331, 332, 333). Moreover, in the second coil and a group (31b), although electric conductors (33) will be connected by junction, since junction of electric conductors (33) can be centralized on the second coil and a group (31b), it becomes possible to make a manufacturing process easy.

[0017] In invention according to claim 5, an electric conductor (33) is arranged only in the direction of a path in a slot (35). In the first coil and the group (31a), as for the electric conductor (33), the electric conductors (33) with same array turn from the direction outermost-layer-of-drum side of a path within the slot (35) of 1 and array turn from the direction innermost layer side of a path within other slots (35) are connected. In the second coil and the group (31b), the electric conductor (33) is characterized by connecting the electric conductors (33) which are extended from a slot (35) which is extended by the hoop-direction retrose by turns and is different from the direction outermost-layer-of-drum side of a path within the slot (35) of 1, and adjoin in the direction of a path.

[0018] Since the joint for this forming the coil (315) with which the lap winding (311 313) and the wave winding (312 314) were intermingled in the second coil and a group (31b) turns into the edges of the electric conductor (33) located

in a line in the direction of a path, a junction process can be made still easier. moreover, slot (--- with the composition using the U character-like segment by the case where it is six with few electric conductors (33) per [ 35 ] In the first coil and a group (31a), the electric conductor in the maximum outer-diameter layer of the slot (35) of 1 and the maximum bore layer of other slots (35) is formed of a large segment (331). The electric conductor which is inside only one layer from the maximum outer-diameter layer, and the electric conductor which only one layer has outside from the maximum bore layer of other slots (35) are formed of an inside segment (332). The electric conductor which two-layer has inside from the maximum outer-diameter layer, and the electric conductor which two-layer has outside from the maximum bore layer of other slots (35) are formed of a small segment (333).

[0019] Therefore, after fabricating the turn section (331c, 332c, 333c) of a large segment (331), an inside segment (332), and a small segment (333), three are arranged and it can introduce into a slot (35) simultaneously. Moreover, it is also possible to fabricate simultaneously the turn section (331c, 332c, 333c) of a large segment (331), an inside segment (332), and a small segment (333). Moreover, if a stator winding is constituted in this way, the variant segment from which a large segment (331), an inside segment (332), a small segment (333), and a configuration differ can be held down to five. By the above, productivity is raised further and a manufacturing cost can be reduced.

[0020] In invention according to claim 6, it is characterized by the coil (312 314) of a wave winding being enclosed by the coil (311 313) of a lap winding. In invention according to claim 7, as for the stator winding, even the slot (35) is characterized by being a turn  $(4n+2)$  ( $n$  : natural number) by the neighboring number of turns. Thereby, in order to obtain the desired output of the AC generator for vehicles (1), when you need the stator winding of a turn of odd multiples, there is no interference in a coil end (31a, 31b), and regular connection can constitute a coil.

[0021] In invention according to claim 8, it is characterized by using 2 \*\*\*\*s of stator windings as the coil whose neighboring number of turns even a slot (35) is a turn  $(2n+1)$  ( $n$  : natural number), and carrying out parallel connection of this coil carried out 2 \*\*\*\*s. Thereby, in order to obtain the desired output of the AC generator for vehicles (1), when you need the stator winding of an odd number turn, there is no interference in a coil end (31a, 31b), and regular connection can constitute a coil.

[0022] In addition, the sign in the above-mentioned parenthesis shows a correspondence relation with a concrete means given in an operation form to mention later.

[0023] [Embodiments of the Invention] Hereafter, the AC generator for vehicles of this invention is explained based on each operation form shown in drawing.

(The first operation form) Drawing 1 to drawing 7 is what showed the first operation form of this invention, and drawing 2 to the principal part cross section of the AC generator for vehicles and drawing 8 of drawing 1 are explanatory drawings of the stator of this operation form.

[0024] AC generator 1 for vehicles is equipped with the stator 2 which works as an armature, the rotator 3 which works as a field, the housing 4 which supports a stator 2 and a rotator 3, and the rectifier 5 which changes ac power into a direct current power, and is constituted. It rotates united with a shaft 6 and the rotator 3 is equipped with the Laon Dell type field core 7, a field coil 8, the slip rings 9 and 10, and cooling fans 11 and 12. A shaft 6 is connected with a pulley 20 and a rotation drive is carried out with the engine for a run (not shown) carried in the automobile.

[0025] The Laon Dell type field core 7 is constituted combining the field core of a lot. The Laon Dell type field core 7 is constituted from ends of the \*\*\*\* boss section 71 with a group, and the boss section 71 by the shaft 6 by the disk section 72 prolonged in the direction of a path, and the 12 presser-foot-stitch-tongue-like magnetic pole sections 73. the shaft-orientations end face of housing 4 -- inhalation -- the hole 41 is formed And corresponding to the first coil of a stator 2, group 31a and the second coil, and the direction outside of a path with group 31b, the discharge hole 42 of the cooling style is formed in the periphery both-shoulders section of housing 4.

[0026] A stator 2 is constituted by a stator core 32, the stator winding constituted with two or more electric conductors arranged in the slot 35 formed in the stator core 32, and the insulator 34 which carries out electric insulation of between a stator core 32 and electric conductors. It is the perspective diagram showing the typical configuration of a segment 33 where the partial cross section of a stator 2 is equipped with drawing 2, and a stator core 32 is equipped with drawing 3. As shown in drawing 2, two or more slots 35 are formed in the stator core 32 so that the stator winding of a polyphase can be held. With this operation form, corresponding to the number of magnetic poles of a rotator 3, 36 slots 35 are arranged at equal intervals so that the stator winding of a three phase circuit may be held.

[0027] The stator winding with which the slot 35 of a stator core 32 was equipped can be grasped as 1 one electric conductor, and even electric conductors (this operation form 6) are held in each of two or more slots 35. Moreover, six electric conductors in the slot 35 of 1 are arranged by the single tier from the inside about the direction of a path of a stator core 32 in order of the 1st layer, the 2nd layer, the 3rd layer, the 4th layer, the 5th layer, and the 6th layer. A stator winding is formed by connecting these electric conductors by the predetermined pattern. In addition, with this

operation form, the electric conductor within a different slot 35 is connected in a coil and the section. In one coil and section of an edge of a stator core 32, it is forming two electric conductors by the continuous conductor, and two electric conductors are connected by the continuation section. Moreover, in one coil and section of an edge of a stator core 32, two electric conductors are connected by joining the edge of two electric conductors.

[0028] One electric conductor in each slot 35 is making other one electric conductor in the slot 35 besides a predetermined pole pitch remote, and the pair. In order to secure, and to arrange in line the crevice between two or more electric conductors which can be especially set in a coil and the section, the electric conductor of the predetermined layer within the slot 35 of 1 is making the electric conductor of other layers within the slot 35 besides a predetermined pole pitch remote, and the pair.

[0029] For example, electric conductor of 1st layer 331a within the slot 35 of 1 is making electric conductor 331b and the pair of the 6th layer within the slot 35 besides 1 pole-pitch remote towards the direction of a clockwise rotation of a stator core 32. Similarly, as for electric conductor of 2nd layer 332a within the slot 35 of 1, electric conductor of 3rd layer 333a within the slot 35 of electric conductor of 5th layer 332b within the slot 35 besides 1 pole-pitch remote and 1 is making electric conductor 333b and the pair of the 4th layer within the slot 35 besides 1 pole-pitch remote towards the direction of a clockwise rotation of a stator core 32. Therefore, even layers are made and the electric conductor held in the slot is arranged so that the electric conductor and pair which are symmetrically located about the direction of a path may be made.

[0030] And the electric conductor which makes these pairs is connected by going via the turn sections 331c, 332c, and 333c by using a successive line in one edge of the shaft orientations of a stator core 32. Therefore, in one edge of a stator core 32, the successive line which connects the electric conductor of the 2nd layer and the electric conductor of the 5th layer will surround the successive line which connects the electric conductor of the 3rd layer, and the electric conductor of the 4th layer. Moreover, the successive line which connects the electric conductor of the 1st layer and the electric conductor of the 6th layer will surround the successive line which connects the electric conductor of the 2nd layer, and the electric conductor of the 5th layer. Thus, the connection of an electric conductor which makes a pair is surrounded in one edge of a stator core 32 by the connection of an electric conductor which makes other pairs held in the same slot 35. A inner layer coil end is formed of connection between the electric conductor of the 3rd layer, and the electric conductor of the 4th layer, a medium-rise coil end is formed of connection between the electric conductor of the 2nd layer, and the electric conductor of the 5th layer, and an outer layer coil end is formed of connection between the electric conductor of the 1st layer, and the electric conductor of the 6th layer.

[0031] on the other hand -- electric conductor of 2nd layer 332a within the slot 35 of 1 -- the direction of a clockwise rotation of a stator core 32 -- turning -- electric conductor of 1st layer 331a' within 1 pole-pitch remote and other slots 35 \*\*\*\* -- the pair is made Moreover, electric conductor of 3rd layer 333a' within the slot 35 of 1 It turns in the direction of a counterclockwise rotation of a stator core 32, and is electric conductor of 4th layer 333b' within the slot 35 besides 1 pole-pitch remote. Electric conductor of 5th layer 332b within nothing and the slot 35 of 1 turns a pair in the direction of a counterclockwise rotation of a stator core 32, and it is electric conductor of 6th layer 331b' within the slot 35 besides 1 pole-pitch remote. The pair is made. And these electric conductors are connected by junction in the other-end section of the shaft orientations of a stator core 32.

[0032] Therefore, in the other-end section of a stator core 32, the joint which connects the joint which connects the joint which connects the electric conductor of the 1st layer and the electric conductor of the 2nd layer, and the electric conductor of the 3rd layer and the electric conductor of the 4th layer, and the electric conductor of the 5th layer and the electric conductor of the 6th layer is located in a line in the direction of a path. An adjacent layer coil end is formed of connection between the electric conductor of the 1st layer, and the electric conductor of the 2nd layer, the connection between the electric conductor of the 3rd layer, and the electric conductor of the 4th layer, and connection between the electric conductor of the 5th layer, and the electric conductor of the 6th layer.

[0033] Thus, in the other-end section of a stator core 32, without overlapping, it arranges in the direction of a path and the connection of an electric conductor which makes a pair is arranged in it. Furthermore, two or more electric conductors are offered by the segment which fabricated the electric conductor with the straight angle cross section in the predetermined configuration. It is provided by the large segment 331 which the electric conductor of the 1st layer and the electric conductor of the 6th layer fabricate a series of electric conductors in the shape of about U characters, and become so that it may be illustrated by drawing 3. And while the electric conductor of the 2nd layer and the electric conductor of the 5th layer come to fabricate a series of electric conductors in the shape of about U characters, it is provided by the segment 332, and the electric conductor of the 3rd layer and the electric conductor of the 4th layer are offered by the small segment 333 which comes to fabricate a series of electric conductors in the shape of about U characters.

[0034] The large segment 331, the inside segment 332, and the small segment 333 constitute a basic segment 33. And a



basic segment 33 is regularly arranged into a slot 35, and the coil which carries out the surroundings of a stator core 32 4 round is formed. However, the turn section which connects the segment which constitutes the leader line of a stator winding, the turn section which connects the 2nd round with the 1st round, the turn section which connects the 3rd round with the 2nd round and the 3rd round, and the 4th round consists of variant segments from which a basic segment 33 differs in a configuration. And in the case of this operation form, the number of a variant segment becomes five per one phase.

[0035] About X phase which is one phase of the three-phase-circuit coils, a coil specification view is explained from drawing 4 using drawing 8. A narrow solid line shows a narrow dashed line and the 3rd layer, and a two-dot chain line, a dashed line thick the 5th layer, and a solid line thick the 6th layer show [ the 1st layer ] the 4th layer for a dashed line and the 2nd layer. Moreover, an upper case is the first coil and group 31a which come to arrange the turn section, and the lower berth is the second coil and group 31b which come to arrange a joint. Moreover, the number located in a line in the center of drawing at a horizontal single tier expresses the slot number.

[0036] First, as shown in drawing 4, a segment 33 is arranged every three slots from No. 1 of the slot number. In the second coil and group 31b, the edge of the electric conductor of the 1st layer to which the edge of the electric conductor of the 2nd layer which came out of the slot of 1 came out of the slot besides 1 pole-pitch remote towards the direction of the circumference of a clock of a stator core 32, and the edge of the electric conductor of the 6th layer which came out of the slot of 1 again are joined to the edge of the electric conductor of the 5th layer which came out of the slot besides 1 pole-pitch remote towards the direction And the 1st coil 311 of the lap winding of 2 turns is formed per slot.

[0037] Moreover, as shown in drawing 5, in the second coil and group 31b, the edge of the electric conductor of the 4th layer which came out of the slot of 1 is joined to the edge of the electric conductor of the 3rd layer which came out of the slot besides 1 pole-pitch remote towards the direction of the circumference of a clock of a stator core 32. And the 2nd coil 312 of the wave winding of 1 turn is formed per slot. Similarly, as shown in drawing 6, the 3rd coil 313 of the lap winding of 2 turns is formed per slot, and as shown in drawing 7, the 4th coil 314 of the wave winding of 1 turn is formed per slot.

[0038] As the coils 311-314 of drawing 7 are shown in drawing 8 from these drawing 4, the edge XX1 of the 1st coil 311, the edge XX2 of the 2nd coil 312, the edge XX3 of the 2nd coil 312 and the edge XX4 of the 3rd coil 313, and the edge XX5 of the 3rd coil 313 and the edge XX6 of the 4th coil 314 are connected. And the coil 315 of 6 turns is formed per slot.

[0039] The variant segment from which the configuration differs in the coil of this X phase in the large segment 311 which is a basic segment 33, the inside segment 312, and the small segment 313 The edge XX1 of the 1st coil 311, and the edge XX2 of the 2nd coil 312 The turn section to connect The segment 335 which it has, the segment 336 which has the turn section which connects the edge XX3 of the 2nd coil 312, and the edge XX4 of the 3rd coil 313, the segment 37 which has the turn section which connects the edge XX5 of the 3rd coil 313, and the edge XX6 of the 4th coil 314, and the coil edge X1 It is five of segments 339 which has the segment 338 and the coil edge X2 which it has. It can explain as follows that a variant segment is stopped by five.

[0040] The 1st coil 311 shown in drawing 4 can be obtained in the annular coil which joins regularly as mentioned above and can be done by cutting turn section 332c of a segment 332, while being inserted in the slot 35 of No. 1 and No. 4. Moreover, the 2nd coil 312 shown in drawing 5 can be obtained in the annular coil which joins regularly as mentioned above and can be done by cutting turn section 333c of the small segment 333 inserted in the slot 35 of No. 1 and No. 34.

[0041] Similarly, in the annular coil which joins regularly the 3rd coil 313 shown in drawing 6, and can be done, it can obtain by cutting turn section 331c of the large segment 331 inserted in the slot 35 of No. 1 and No. 4, and turn section 333c of the small segment 333 by which the 4th coil 314 shown in drawing 7 is inserted in the slot 35 of No. 1 and No. 4.

[0042] And one coil 315 is formed by joining the cut edges suitably as mentioned above. Thus, a coil 315 can be formed by cutting four annular coils by four places, connecting the cutting section of the ring of 1, and the cutting section of other rings, and making it one coil. Therefore, the number of required variant segments is five. Y phase and Z phase are formed in the slot from which a phase differs by a unit of 120 degrees mutually like X phase. The coil edges Y1 and Z1 of the coil edge X1 of X phase and Y phase which is not illustrated, and Z phase are connected to a rectifier 5, and the coil edge X2 is connected with Y2 and Z2 which are not illustrated as the neutral point. And as shown in drawing 9, star connection of these three phase circuits is carried out. In the coil shown in drawing 8, the coil edge X1 connected with a rectifier 5 is taken out from the first coil and group 31a side by shaft orientations.

[0043] The manufacturing process of a stator winding is explained below. A basic segment 33 is arranged so that turn section 331c of the U character-like large segment 331 may surround turn section 332c of the U character-like inside



segment 332, and is inserted from the one side of the shaft-orientations side of a stator core 32 so that turn section 332c of the U character-like inside segment 332 may surround turn section 333c of the U character-like small segment 333. that time -- one electric conductor 332a of the inside segment 332 is inserted in the 2nd layer of the slot of the above 1, and one electric conductor 333a of the small segment 333 is inserted in the 1st layer of the slot of 1 of a stator core 32 for one electric conductor 331b of another side of the large segment 331, the electric conductor which is another side of the inside segment 332 is also inserted in the 5th layer of a slot besides the above from the slot of the above 1 of a stator core 32 at the 6th layer of a slot besides 1 pole-pitch remote at a clockwise rotation, and the electric conductor of another side of the small segment 333 is also inserted in the 4th layer of a slot besides the above.

[0044] consequently, it is shown in drawing 2 -- as -- as the electric conductor above-mentioned from an innermost layer side to the slot of 1 -- Bays 331a, 332a, and 333a, 333b', 332b', and 331b -- ' It is arranged at a single tier. here -- 333b', 332b', and 331b -- ' They are an electric conductor within the slot 35 besides 1 pole-pitch \*\*\*\*\*, and the bay of each large minor segment which is making the pair.

[0045] In the second coil and group 31b, Joints 331d and 331e are leaned in the direction in which the large segment 331 opens the electric conductor located in the 1st layer and the 6th layer by 1.5 slots after insertion. And Joints 332d and 332e are leaned in the direction in which the inside segment 332 closes the electric conductor of the 2nd layer and the 5th layer by 1.5 slots. And Joints 333d and 333e are leaned in the direction in which the small segment 333 opens the electric conductor of the 3rd layer and the 4th layer by 1.5 slots.

[0046] The above composition is repeated about the segment 33 of all the slots 35. and the second coil and group 31b - setting -- joint of 1st layer 331d' 332d of joints of the 2nd layer -- and Joint of 3rd layer 333d' Joint of 4th layer 333e' And joint of 5th layer 332e, and joint of 6th layer 331e' It is joined by meanses, such as welding, ultrasonic welding, arc welding, and soldering, and connects electrically.

[0047] In addition, a basic segment 33 is fabricated by the copper monotonous shell, the press, etc. by the abbreviation type configuration for U characters. The large segment 331, the inside segment 332, and the small segment 333 may be fabricated individually, and may fabricate three copper monotonous shells simultaneously. Moreover, each segments 331-333 may twist and form an electric conductor with a linear straight angle cross section. The configuration of the turn section is good also not only as the typeface of KO as shown in drawing 3 but circular.

[0048] With this operation form, the composition which arranges this in one slot 35 is adopted by making into one unit the  $4n+2$  electric conductor ( $n$  : the natural number and this operation form  $n=1$ ) arranged in the direction of a path in the slot 35. And on the other hand,  $m$  electric conductors are made to incline in \*\* over the perimeter of a stator core 32 the inner layer side which comes out of one slot 35, and  $m$  electric conductors are made to incline in the other directions over the perimeter of a stator core 32 in one edge of a stator core 32 the outer layer side which comes out of one slot 35. Moreover, the  $4n+2$  electric conductor which comes out of one slot 35 is made to incline in the direction of alternation over the perimeter of a stator core 32 in the other-end section of a stator core 32 for each class.

[0049] By adopting this configuration, almost all electric conductors are offered by the basic segment 33 of the shape of U character arranged multiplex. In addition, the proper place is equipped with the variant segment. In addition, it is  $m = (4n+2)/2$ . One coil and group are formed in the turn section arranged m-fold [ of these basic segments 33 ]. Moreover, the coil and group of another side are formed at the edge which projects from the stator core 32 of these segments.

[0050] The point of two or more segments is joined in the coil and group of this another side. Especially two or more joints [ form / operation / this ] are exposed to the front face of a coil and a group, and it is arranged annular / multiplex /. namely, all joints -- a coil and a group -- it is arranged most outside and arranged regularly For this reason, junction equipment can be made to reach from an outside directly to all joints. And positioning of the junction equipment to a joint can be ensured and advanced automation of a junction process is attained.

[0051] This joint is arranged so that it may make annular [ m-fold ], and it forms a series of stator windings in collaboration with the turn section of the segment arranged m-fold in the coil and group of an opposite side. And the coil of a lap winding and the coil of a wave winding are intermingled in the stator winding of one phase. Namely, with this operation form, it sets in one coil and group. Connect two electric conductors of the direction of inside and outside symmetrical layer within the slot 35 of two predetermined pitch remotes by the turn section arranged m-fold, and it sets in the coil and group of another side. By adopting the composition of connecting two electric conductors of a layer with which it adjoins within the slot 35 of two predetermined pitch remotes, the stator winding in which the coil of a lap winding and the coil of a wave winding are intermingled is formed.

(The operation effect of the first operation form) By considering as the above-mentioned composition, the electric conductor of each class inclines in the same direction in the first coil, group 31a, the second coil, and group 31b. Therefore, the coil 315 of 6 turns can be formed per slot, without the segments of the same layer interfering. At this

time, a variant segment requires only five per one phase, and all others can constitute a coil from arrangement of a basic segment 33.

[0052] Moreover, a joint can be arranged with the second coil and group 31b, and workability can be improved. On the other hand, many joints can be arranged at intervals [ annular / three-fold ]. Therefore, proximity of the distance between joints can be suppressed and junction processes, such as welding, can be made easy. For example, improvement in productivity is possible for positioning of welding equipment, the alignment to a part welding, etc. becoming easy etc.

[0053] Furthermore, in the first coil and group 31a, the segment 33 forms the three-fold turn section so that the large segment 331 may surround the inside segment 332 and the inside segment 332 may surround the small segment 333. Therefore, since it is also possible that three segments are arranged and it can introduce into a slot simultaneously or to manufacture three simultaneously in the fabricating operation of the turn section, productivity can be raised more.

[0054] Moreover, the coil of this operation form is constituted so that the coil of the lap winding formed with the electric conductor of the 1st layer, the 2nd layer, the 4th layer, and the 6th layer may enclose the coil of the wave winding formed with the electric conductor of the 3rd layer and the 4th layer. Since according to the above-mentioned operation form the coil of a lap winding and the coil of a wave winding are connected and the coil of one phase is constituted, necessary output characteristics can be obtained.

[0055] And the number of turns which is not obtained only by the lap winding is realizable by combining many numbers of turns obtained by the coil of a lap winding, and the few number of turns obtained by the coil of a wave winding. Furthermore, according to the above-mentioned operation form, the number of use of a variant segment can be lessened. Moreover, since the joint of a segment is centralized on one coil and section, junction work is easy.

[0056] Thus, according to the above-mentioned operation form, it is compatible in the outstanding productivity and required output characteristics.

(The second operation form) The coil of more numbers of turns than the first operation form is realizable as follows.

[0057] the first operation form -- the number of several  $N =$  turns of the electric conductor within a slot -- although referred to as (T) = 6 -- several [ of the electric conductor within a slot ] -- in the case of  $N = 4n + 2$  (n : natural number), the same composition is applicable. For example, as  $n = 2$ , the electric conductor within a slot can be made into ten, and the coil of one phase can be constituted. With this 2nd operation form, as the basic segment 33 of the first operation form is surrounded by the segment of the shape of 2 more character [ U ], the five-fold turn section is formed. Drawing 10 is the \*\* type view showing the first coil in case the number of electric conductors per slot is ten, and group 31a. The coil of a lap winding is formed by the 5th-fold segment by the maximum inside segment among the segments of the shape of U character put on five-fold with the 4th-fold [ the 3rd-fold wave winding, the inside to a double eye and a segment, and inside to ]. And one coil can be obtained by connecting these by the variant segment like the first operation form. In addition, since the coil of the lap winding of two rings is formed of two U character-like segments added, the number of the increasing variant segments is 2.

[0058] When the number of electric conductors per slot increases like 14 and 18, the same coil can be obtained by forming a lap winding by every two U character-like segments added outside. Moreover, whenever the number of electric conductors per slot increases four, the number of variant segments increases every [ 2 ]. Thus, also in the obtained coil, the coil of  $4n + 2$  per slot turn can be formed, without the segments of the same layer interfering, since the electric conductor of each class can be made to incline in the same direction. At this time, a variant segment is [  $2n + 3$  ] sufficient per one phase, and all others can constitute a coil from arrangement of a basic segment 33.

[0059] Moreover, a joint can be arranged with the second coil and group 31b, and workability can be improved. On the other hand, many joints can be arranged at intervals [ annular /  $2n + 1$  pile ]. Therefore, proximity of the distance between joints can be suppressed and junction processes, such as welding, can be made easy. For example, improvement in productivity is possible for positioning of welding equipment, the alignment to a part welding, etc. becoming easy etc.

[0060] Furthermore, since it is also possible that a segment is arranged and it can introduce into a slot simultaneously or to manufacture two or more simultaneously in the fabricating operation of the turn section, productivity can be raised more.

(The third operation form) It reached for a start and the case where the number of turns was even per slot was shown in the second operation form. however, in order to obtain the desired output of the AC generator for vehicles, constituting a coil as follows cuts to make the number of turns per slot into odd number

[0061] By connecting in parallel what made in-series what connected the 1st coil 311 and the second coil 312 in the first operation form in series, and the third coil 313 and the fourth coil 314, as shown in drawing 11, what connected the coil of 3 turns per slot can be obtained. Thus, the coil of  $2n + 1$  per slot turn, i.e., an odd number turn, can be obtained by dividing two or more coils which consist of electric conductors of  $4n + 2$  per slot (n : natural number) book

two, and carrying out parallel connection.

[0062] While being able to raise the productivity of segment work and a coil process and being able to reduce a manufacturing cost by this, the coil of an odd number turn can be obtained.

(others -- operation form) the configuration of a basic segment 33 was made into the shape of U character to which the turn section of the segment of 1 surrounds the turn section of other segments in the first to third operation form. However, a cylindrical segment may be inserted in a slot 35 and the portion which had connected by the turn section of a segment in the first to third operation form may be connected by junction. In this case, in both coil ends, junction connects and an electric conductor forms an electric coil. And in one coil end, the joint is located together with annular [ of two or more layers ], and in the coil end of another side, it is located so that other joints may surround the joint of 1.

[0063] Moreover, in one coil end, it is good also as composition which other joints surrounded the joint of 1 and connected the electric conductor which adjoins in the direction of a path by the U character-like segment in the coil end of another side. In addition, although the leader line was formed in the first coil and group 31a side with the third operation form from the above first, you may form a leader line in the second coil and group 31b which are a joint side.

[0064] Moreover, the pole of a rotator 3, the source resultant pulse number of a stator winding, and the pole of a stator can be set up according to the output characteristics demanded. For example, arbitrary things, such as a rotator of 16 poles and a stator winding of five phases, are employable. Moreover, it is good also as a usual number of double precision in the pole of a stator to the pole p of a rotator, and the source resultant pulse number n of a stator winding. For example, a stator core equipped with 72 slots can be used about the rotator of 12 poles, and the stator winding of a three phase circuit. In this composition, 2 sets of stator windings by which three-phase-circuit connection was carried out can be constituted. And necessary output characteristics can be obtained by compounding the output of each class. Moreover, under the same output, since the cross section of an electric conductor can be made small, processing of a segment becomes easy.

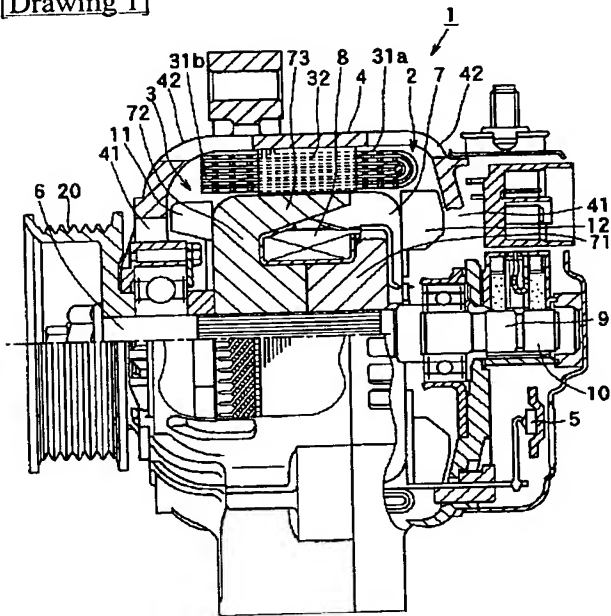
[0065] In addition, with the above-mentioned operation form, although the stator winding carried out star connection of X phase, Y phase, and the Z phase and formed them, delta connection of X phase, Y phase, and the Z phase may be carried out, and it may form them. Moreover, with the above-mentioned operation form, although the segment used the thing of a straight angle cross section, from a viewpoint of a space factor, the bays 331a, 331b, 332a, 332b, 333a, and 333b held in a slot 35 at least may be wanted to be straight angle cross sections, it may be carried out, and a bur and a round-head cross section are sufficient as it.

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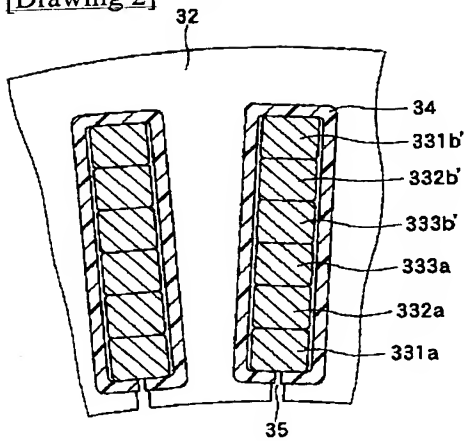
[Translation done.]

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

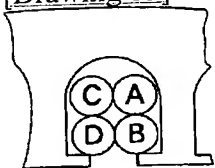
[Drawing 1]



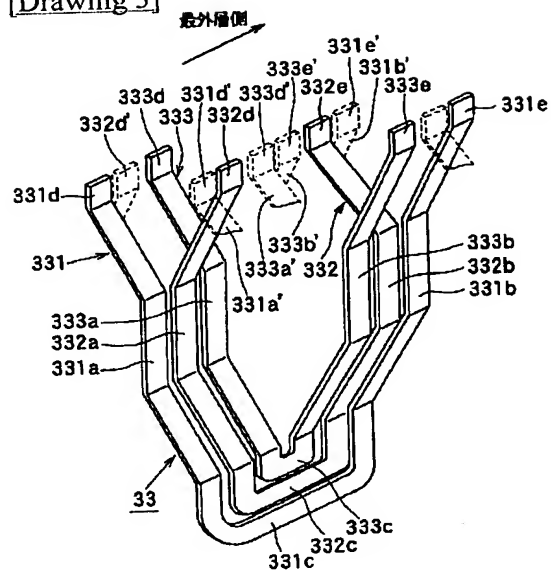
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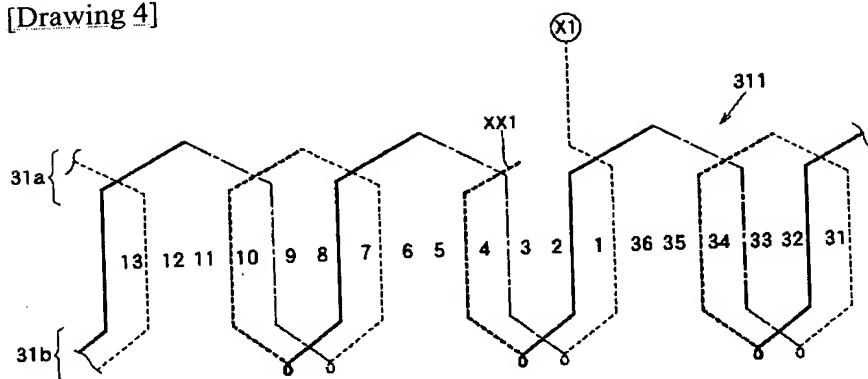
[Drawing 13]



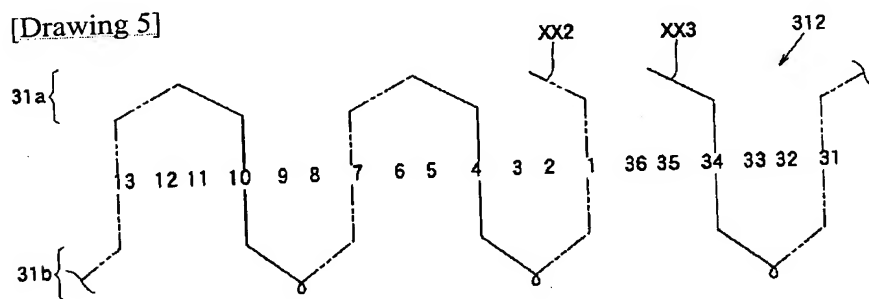
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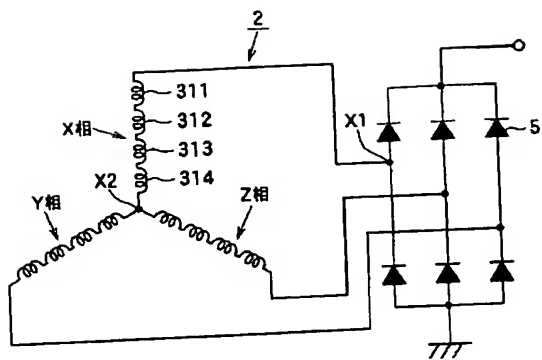
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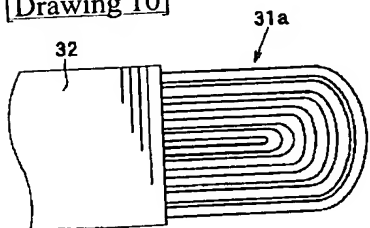
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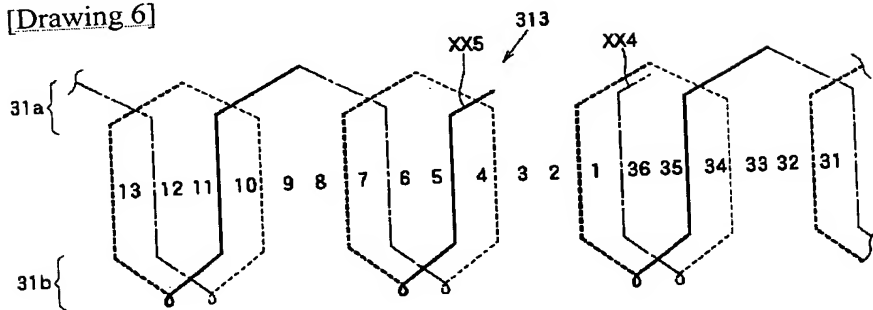
[Drawing 9]



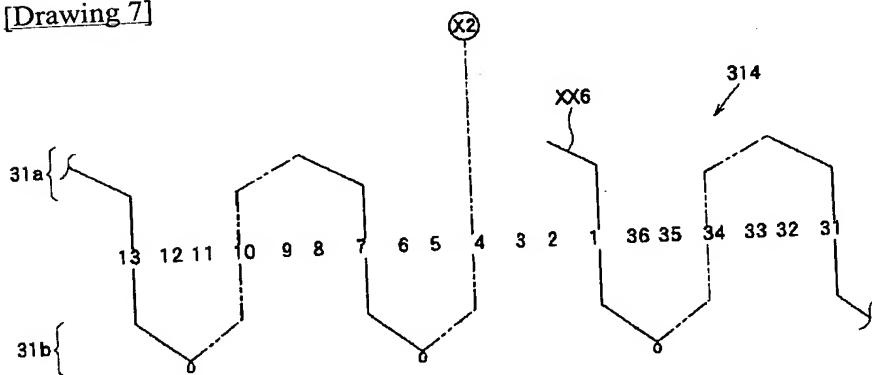
[Drawing 10]



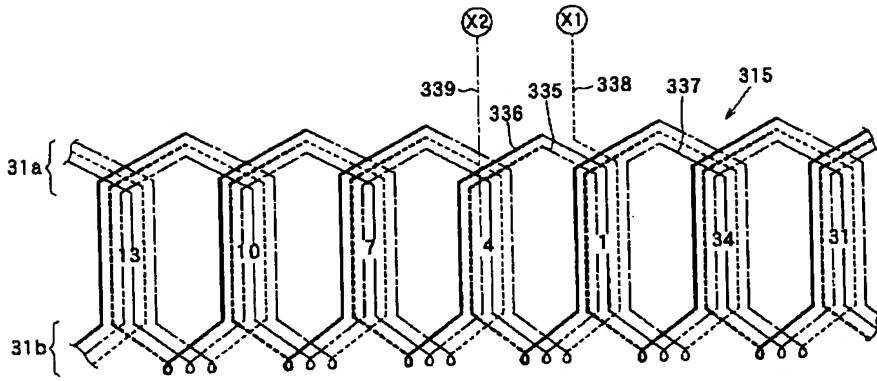
[Drawing 6]



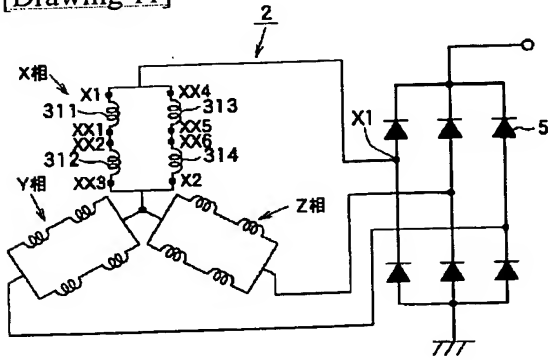
[Drawing 7]



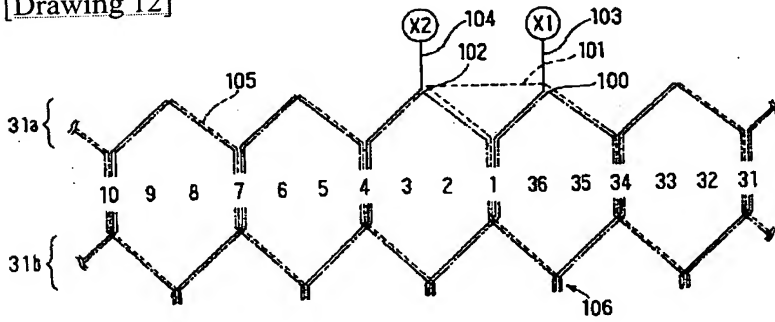
[Drawing 8]



[Drawing 11]



[Drawing 12]



[Translation done.]